

Network Centric Warfare: A Revolution in Military Affairs

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CNO-N6
10 June 1997**

*“There is nothing more difficult to take in hand, more
perilous to conduct, or more uncertain in its success
than to take the lead in the introduction of a new order
of things.”*

Niccolo Machiavelli, The Prince

Network Centric Warfare: A Revolution in Military Affairs

“... it’s a fundamental shift from what we call platform-centric warfare to something we call network-centric warfare.”

**Admiral Jay L. Johnson, USN
Chief of Naval Operations**



What is a Revolution?

“A fundamental change ...”

- in thinking**
- in visualizing**
- in preference**

“A displacement of the conceptual network ...”

“Non-cumulative developmental episodes ...”

“A change of paradigm ... ”

Previous Scientific Revolutions

Astronomy

Copernican Revolution

- Ptolemaic (Geocentric)  - Copernican (Heliocentric)


Physics

Newtonian Revolution

- Galilean Dynamics  - Newtonian Dynamics

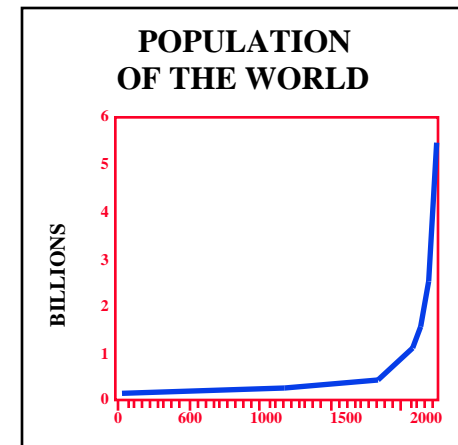
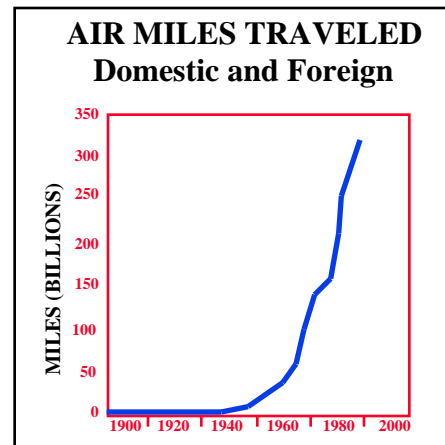
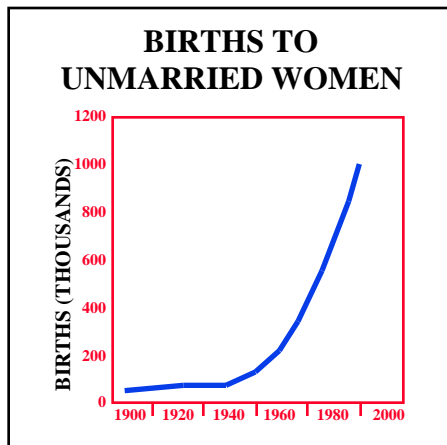
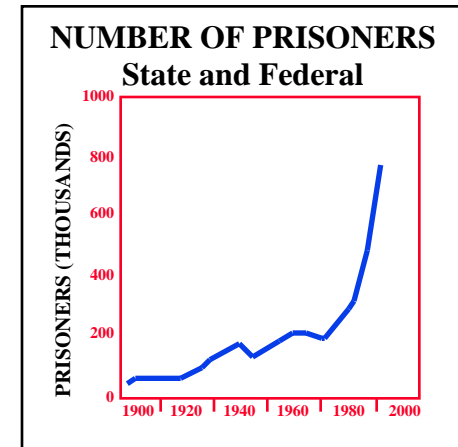
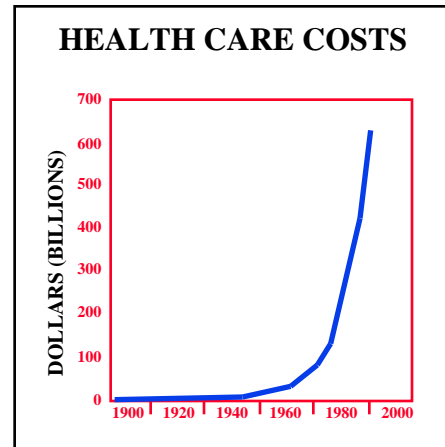
Physics

Modern Physics

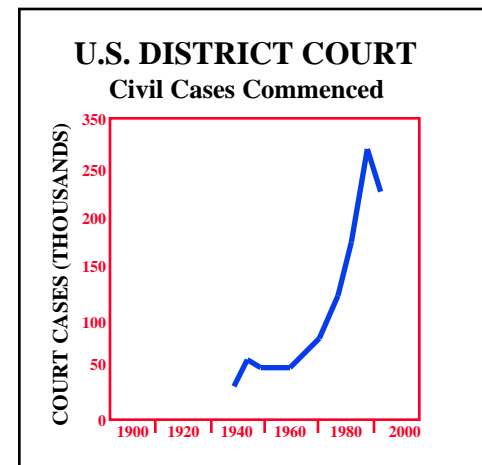
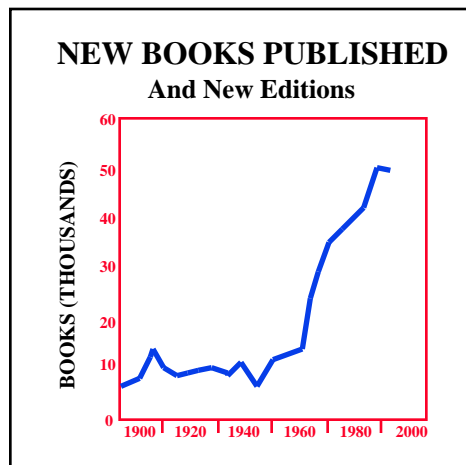
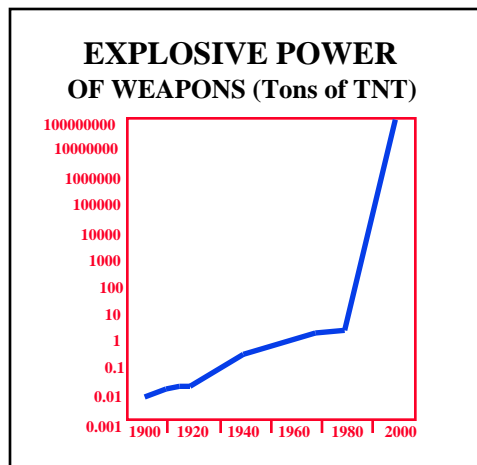
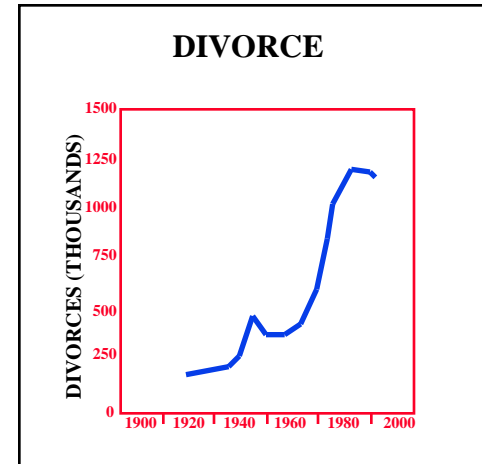
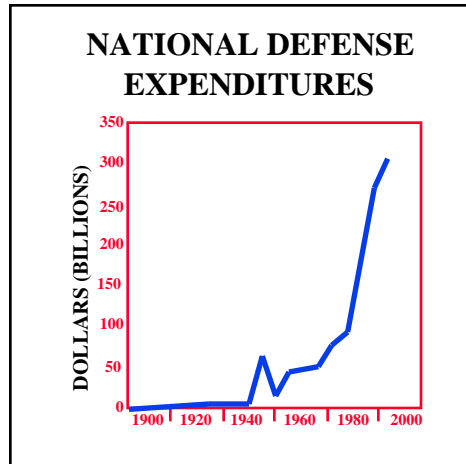
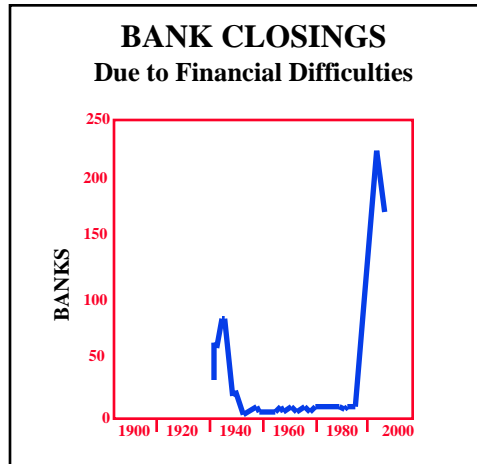
- Newtonian Dynamics  - Relativistic Dynamics
- Quantum Mechanics



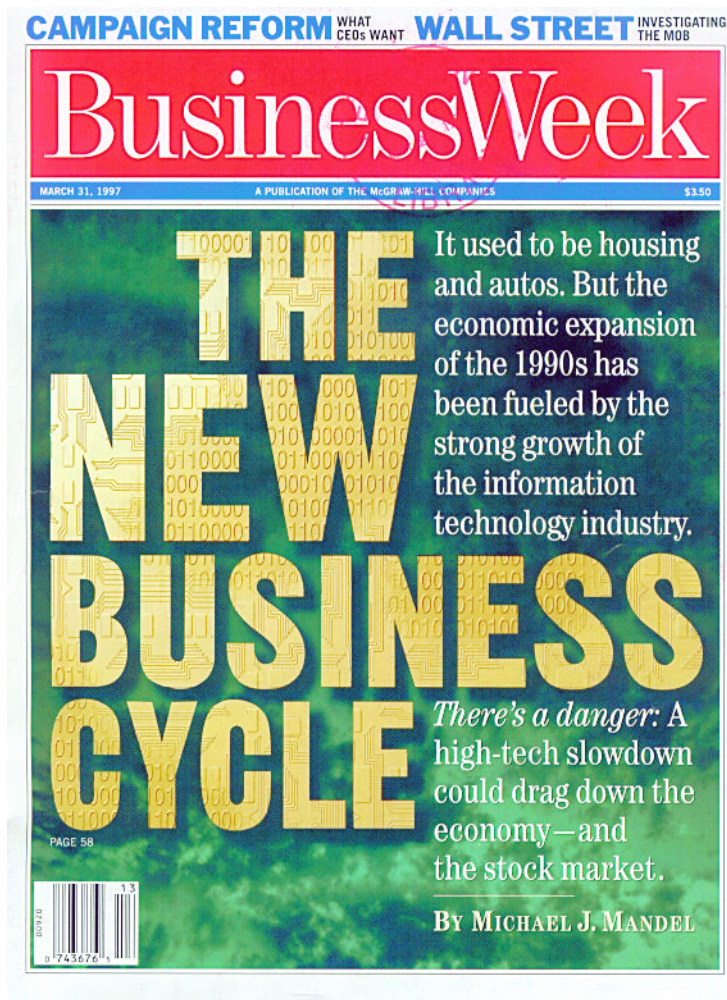
Trends



Not All Trends Continue...

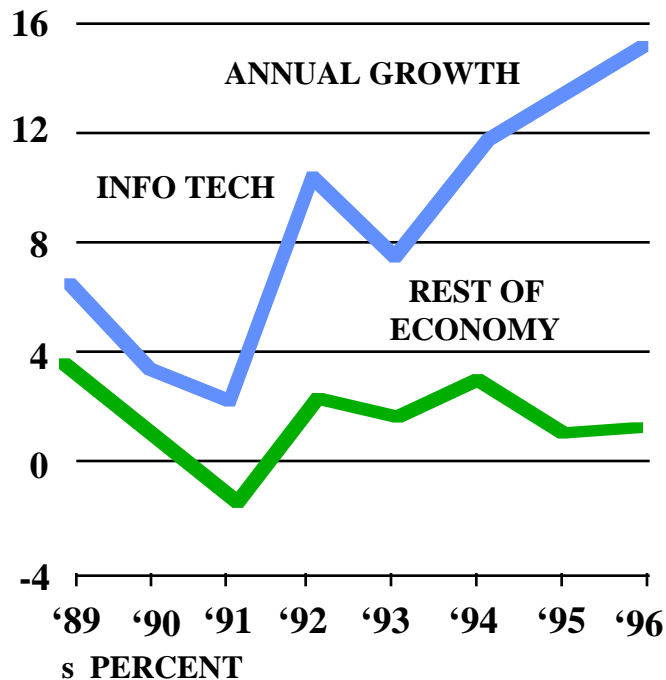


The New Business Cycle

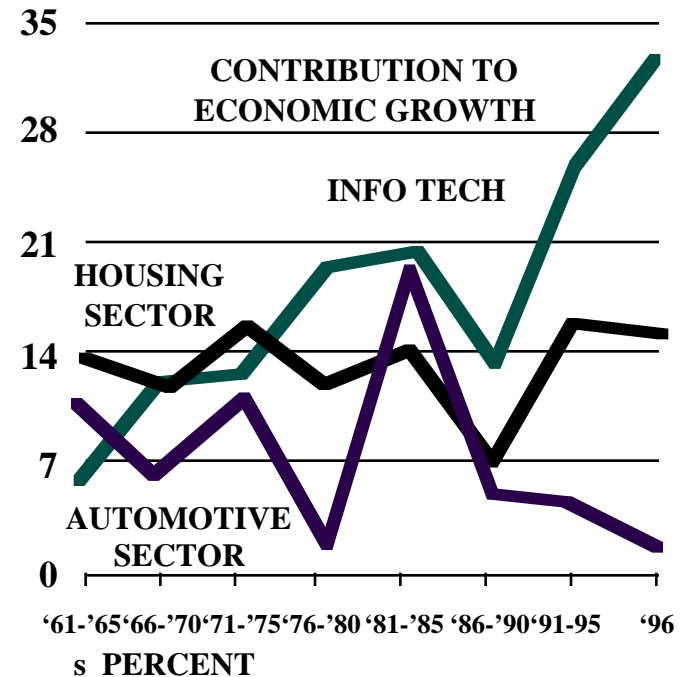


The New Business Cycle

The Information Technology Sector Is Accelerating ...



... Dominating The Expansion ...



Implication: Information Technology is new engine of economic growth

Source: Business Week / March 31, 1997




The Changing Dynamics of Competition

Coevolving Ecosystems


Information Technology

- Platform Centric
- 
- Network Centric

Business

- Company Centric
- 
- Network Centric
 - Increasing Returns vs. Decreasing Returns

Warfare

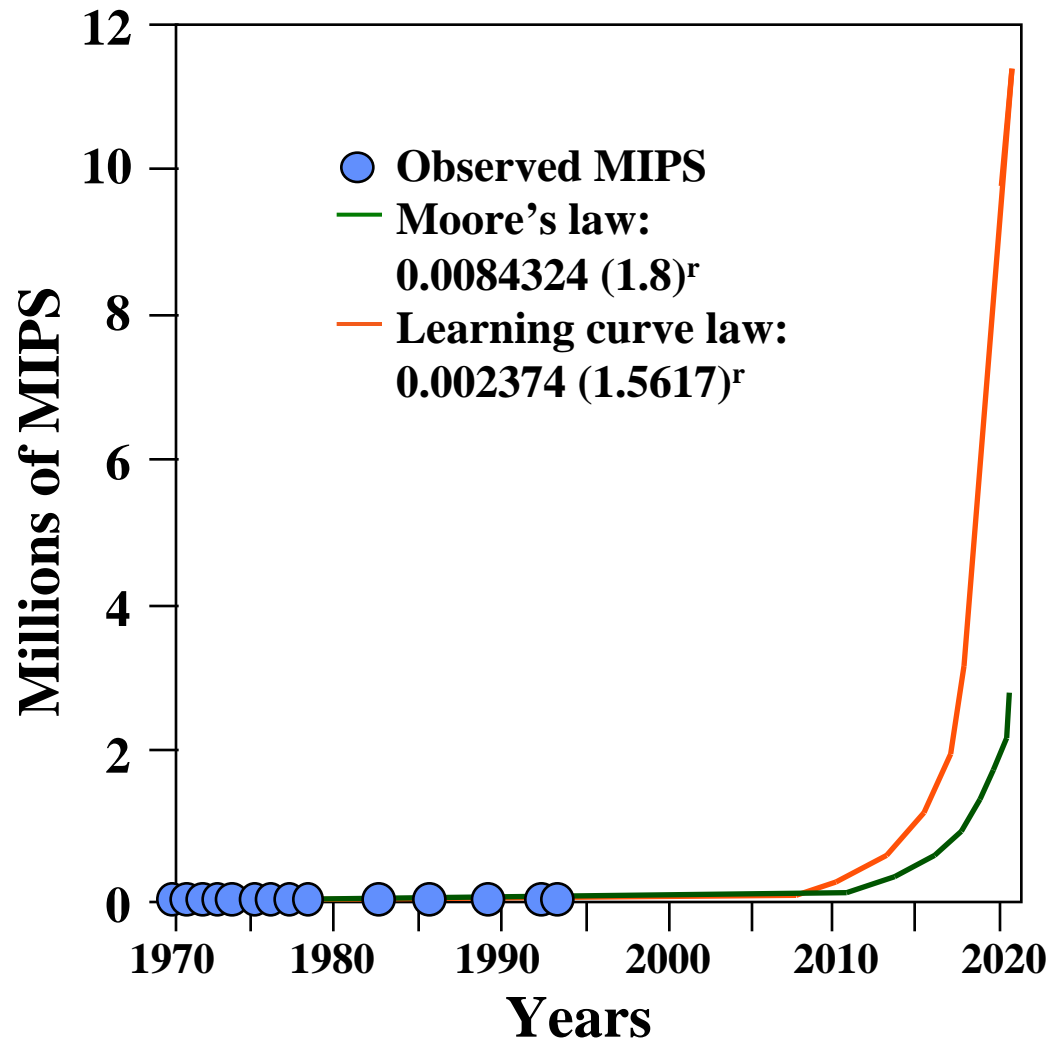
- Platform Centric
 - Attrition
- 
- Network Centric
 - Speed of Command



Coevolving Information Ecosystems

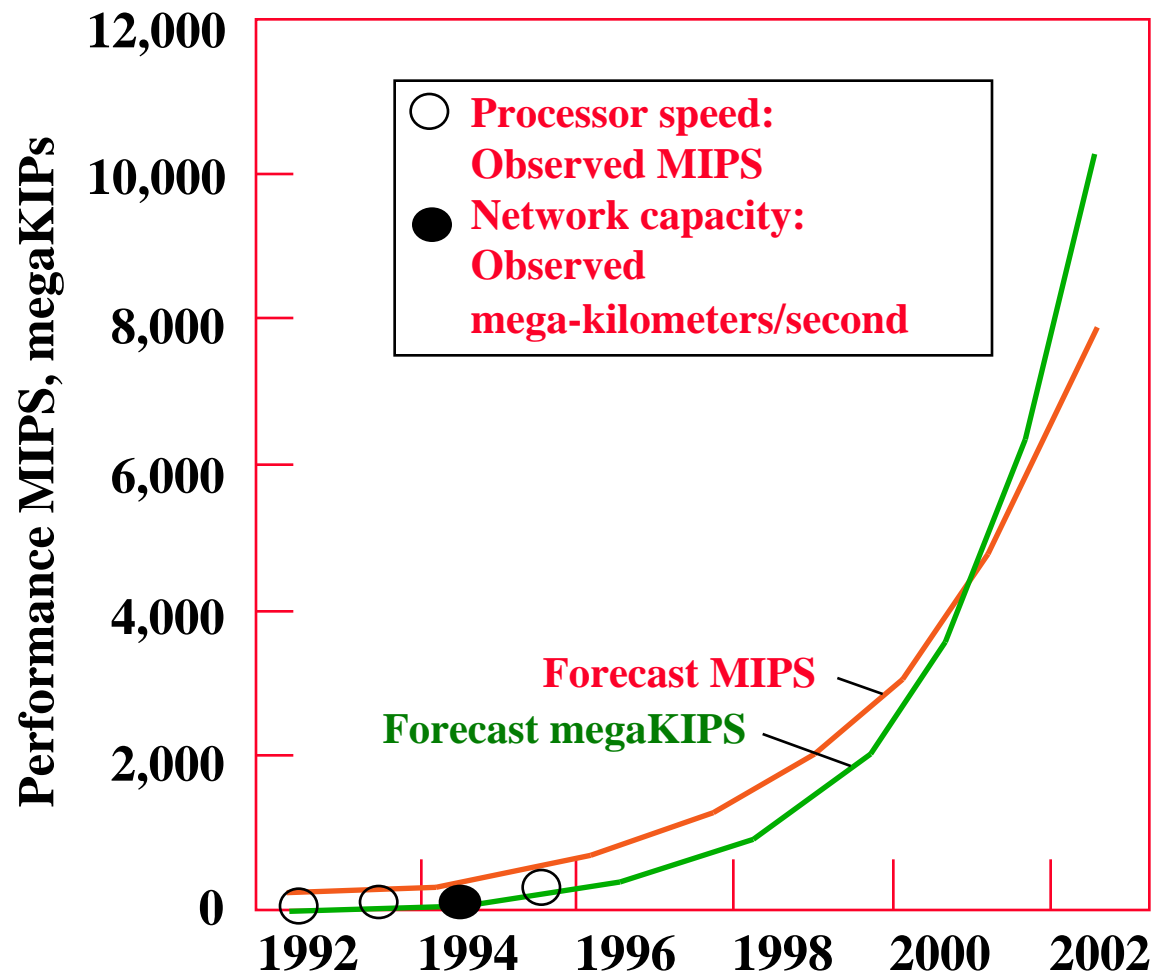
- **Corporate Strategies**
 - **Sun Microsystems**
 - » **“The Network is the Computer”**
 - **IBM**
 - » **Old Focus: Platform Centric (“Big Iron”)**
 - » **New Focus: “Network Centric Computing”**

Evolution of Computing Power



Source: Professor Ted Lewis, *Computer Magazine*, April 1996

Communications is Catching Computing Speed



Source: Professor Ted Lewis, *Computer Magazine*, May 1996


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Increasing Returns vs. Decreasing Returns

- **Decreasing Returns**

- (Economy A)

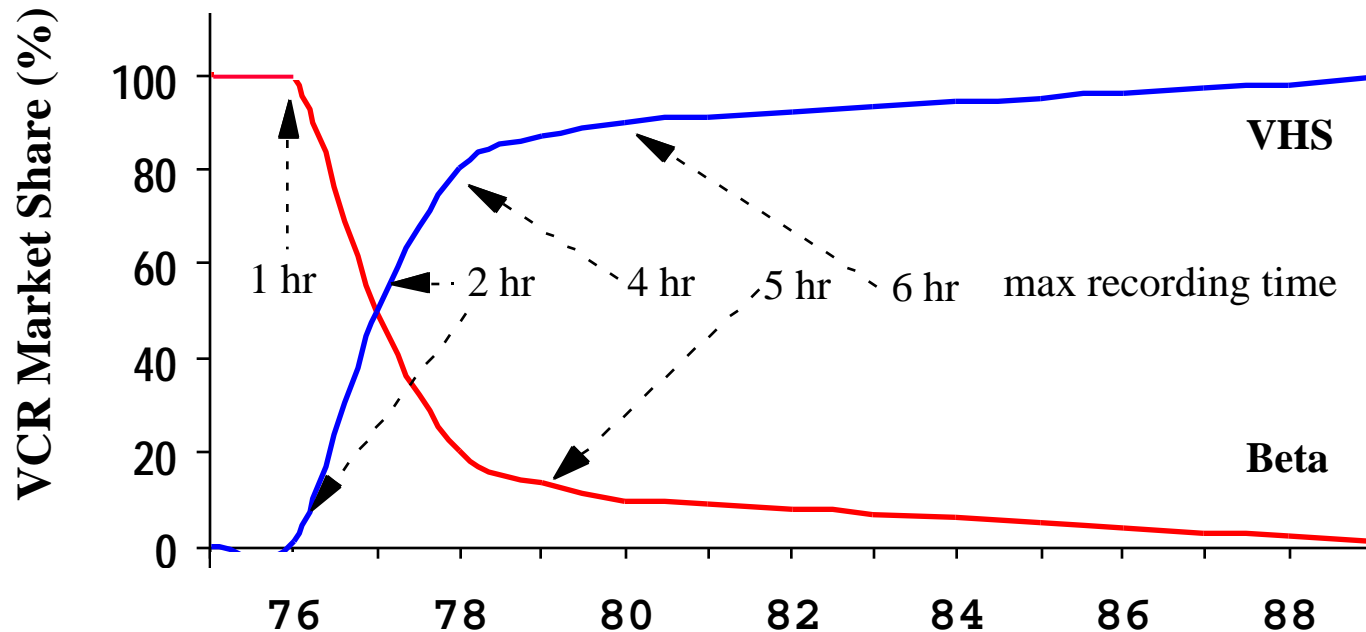
- **Absence of Mechanisms for Product Lock-in**
 - » **Competing products are Interchangeable**
 - **Market share equilibrium**
 - » **Increased costs to achieve greater market share**
 - **Examples:**
 - » **Consumer Non-Durables**
 - **Food**
 - » **Consumer Durables**
 - **Automobiles**

- **Increasing Returns**

- (Economy B)

- **Mechanisms for Product Lock-in**
 - » **Competing products are not interoperable**
 - » **Network Effects**
 - » **User skills**
 - **Examples:**
 - » **Standards**
 - **VHS vs. Beta**
 - **MAC vs. DOS/Windows**
 - » **Skill Set**
 - **“QWERTY” Typewriter**
 - **Ethernet vs. ATM**

Increasing Returns Case Study: Beta vs. VHS



| | | | |
|-------------------------|-----------|---------|---------------|
| Operational Requirement | 2 sitcoms | 1 movie | football game |
| Recording Time | 1 hour | 2 hours | 4 hours |

Source: Dominant Technology Adaptation Study, 1997, Center for Naval Analyses



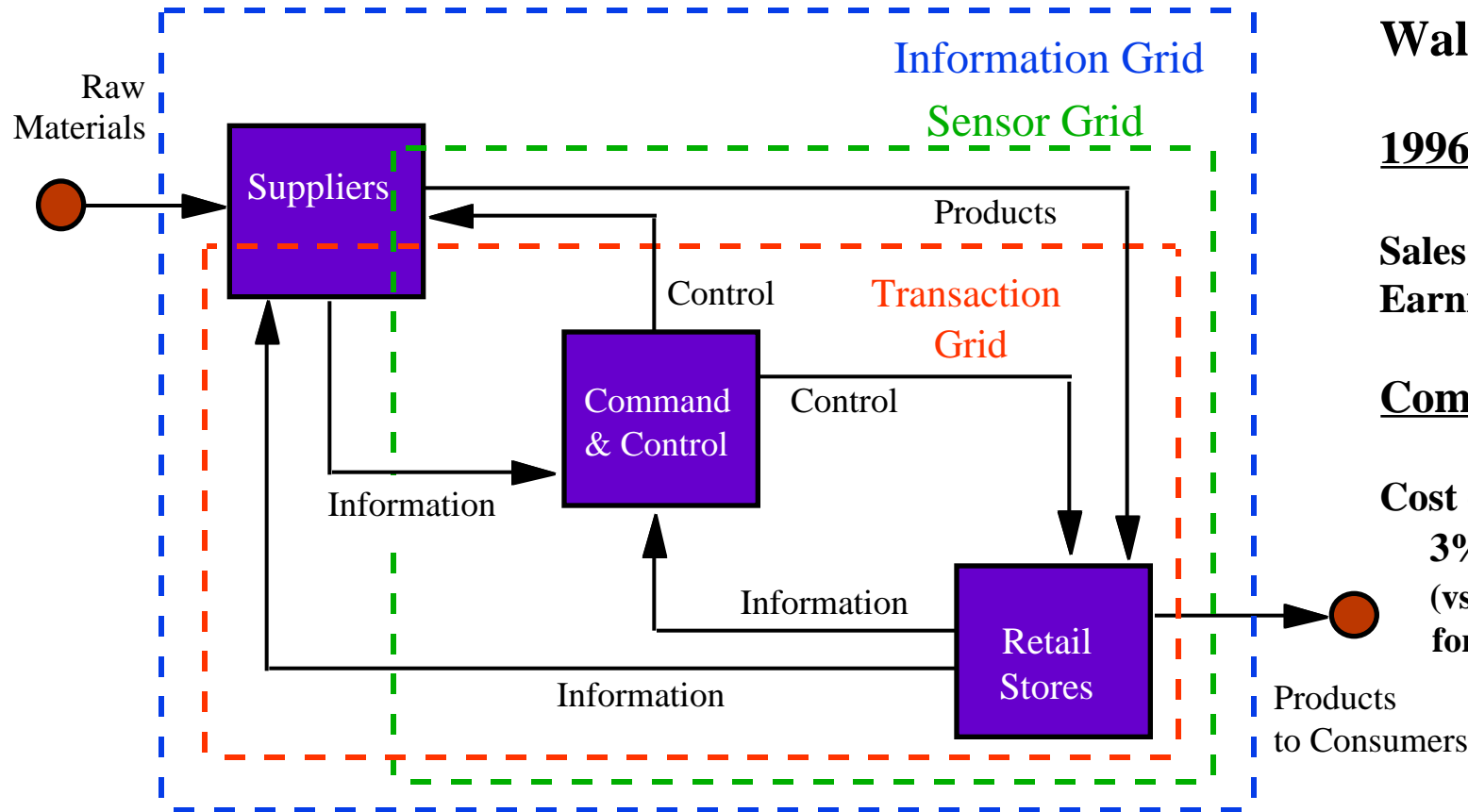
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Competitive Space: Retail

- **Competition between Retail Ecosystems**
 - **Wal-Mart vs. K-Mart**
 - **Business Model**
 - » **Maximize Value to Customer (Price, Selection, Service)**
 - » **Maximize Profit for Retailer**
 - **Maximize number/profitability of transactions**
 - Develop awareness of what customer is buying
 - Supply stores what the customer is buying
 - **Minimize costs of transactions**
 - Cost of Advertising
 - Cost of Labor
 - Cost of Plant (Retail Stores, Warehouses)
 - Cost of Products (Price retailer pays to supplier of products)
 - Logistics Costs: Inventory (Retail Store, Warehouse, Intransit)



Network Centric Retailing



Wal-Mart

1996 Results¹

Sales: \$104.9 Billion
Earnings: \$3.056 Billion

Competitive Edge²

Cost of Distribution
3% of Sales
(vs. 4.5 to 5%
for Competition)

“Competitive Space” Awareness is a key Competitive Advantage in the Retail Sector

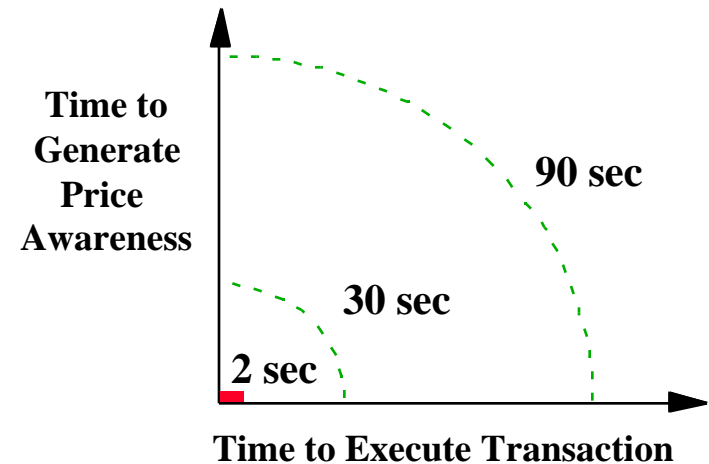


Source: 1. Investors Business Daily, 1997
2. *The Death of Competition*, 1996

Competitive Space: Bond Trading

- Competition between Securities Trading Ecosystems

- Deutsche Morgan Grenfell Inc. vs. Goldman Sachs vs. Merrill Lynch vs. Cantor Fitzgerald, etc.
- Competition Based on Time
- Business Model
 - Maximize Profit for Trading Firm
 - Increase number and profitability of transactions
 - Maximize Value to Customer
 - Price
 - Selection
 - **Service = Transaction Time**



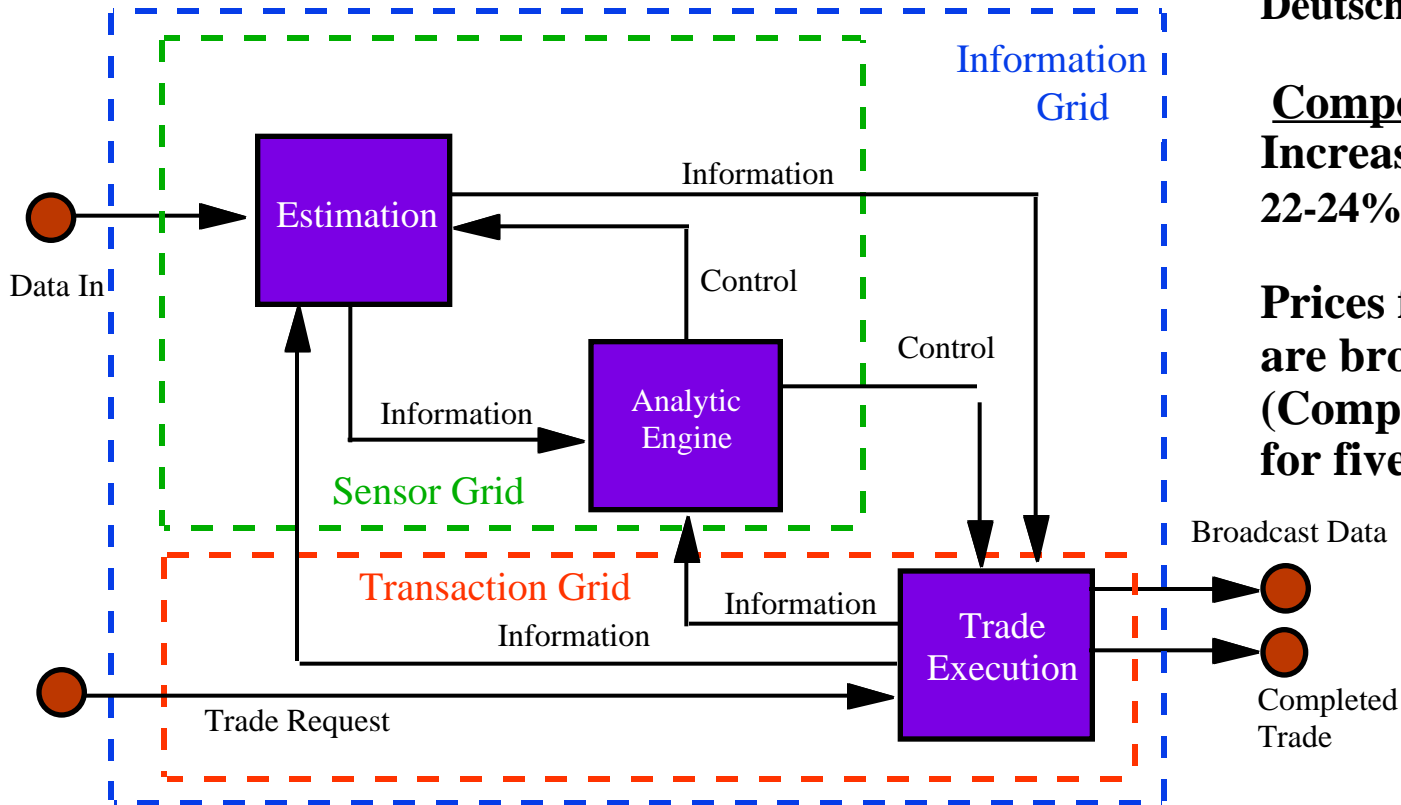
- **DMG - within 2 seconds 95% of the time**
- **Competition**
 - 30 sec to 90 sec
 - 30 sec: 10% of the time



Source: Interview with Christopher J. Carroll, Managing Director, Global Electronic Trading, DMG

Network Centric Bond Trading

“The Network is the MarketSM”



Company:

Deutsche Morgan Grenfell Inc.

Competitive Edge

**Increased Trading Volume -
22-24% per Month**

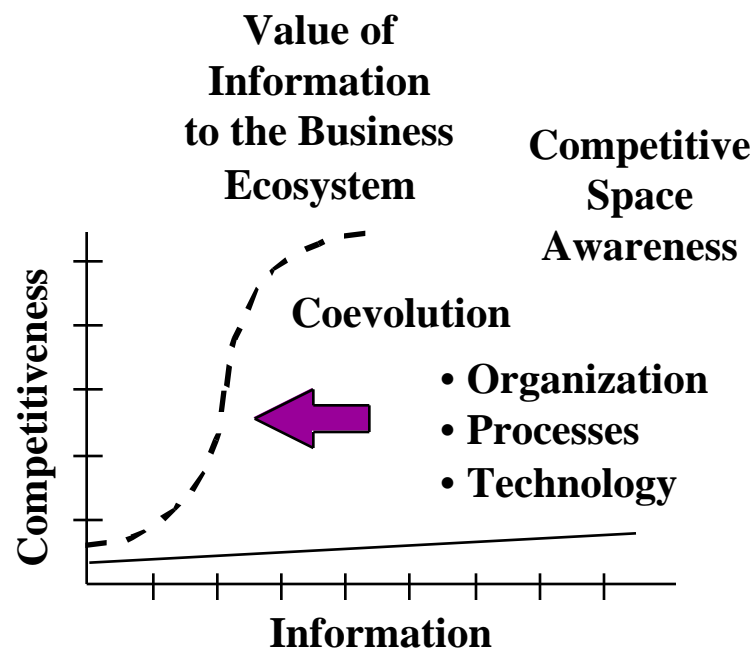
**Prices for 210 to 230 bonds
are broadcasted continuously
(Competitors provide data
for five benchmarks)**

“Competitive Space” Awareness is DMG’s Competitive Advantage in Securities Trading



Source: Interview with Christopher J. Carroll, Managing Director,
Global Electronic Trading, DMG

Coevolving Business Ecosystems

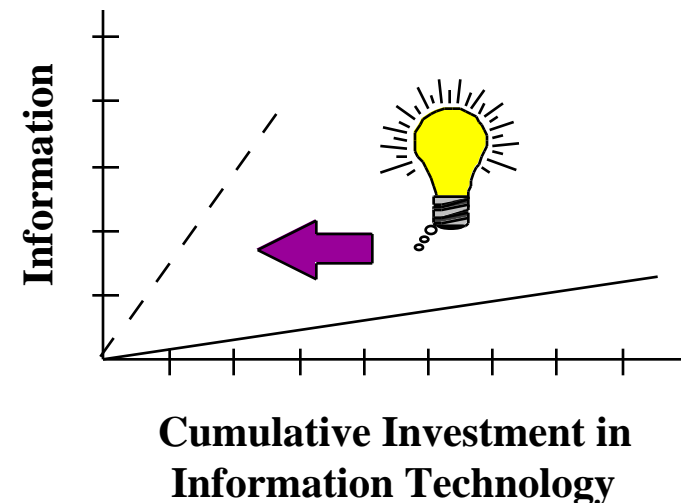


• Information

Can be translated to a competitive advantage through coevolution of organization, processes, and technology

• Information

- Implement at minimum cost with reduced cycle times



Coevolving Business Ecosystems

- **Source of Competitive Edge**
 - Information grids enable network centric computing
 - Sensor grids create awareness of competitive space
 - Transaction grids exploit awareness to provide a competitive edge
- **Emergence of new modes of competition**
 - Competition between Business Ecosystems
 - » Enabled by coevolving information ecosystems
 - » Competition based on time
 - Competition characterized by Increasing Returns
 - » Implications for Warfare




The Changing Dynamics of Competition

Coevolving Ecosystems


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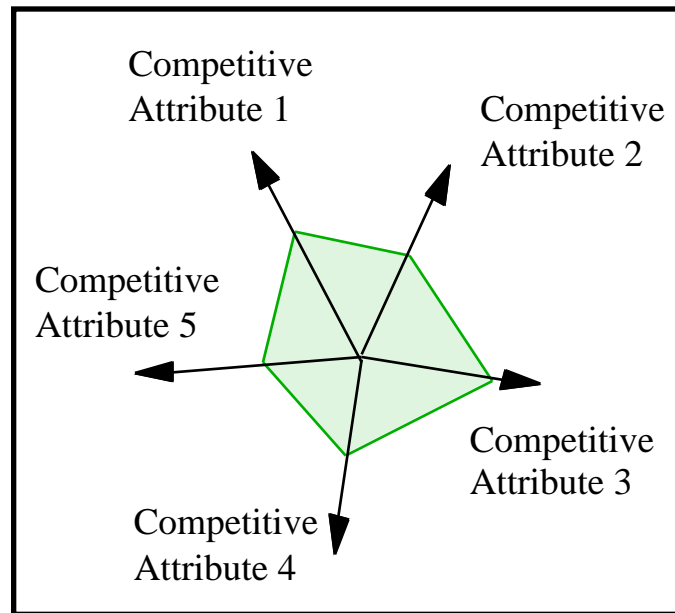
Warfare

- Platform Centric
- 
- Network Centric
 - Speed of Command



Strategy vs. Operational Effectiveness

Strategy



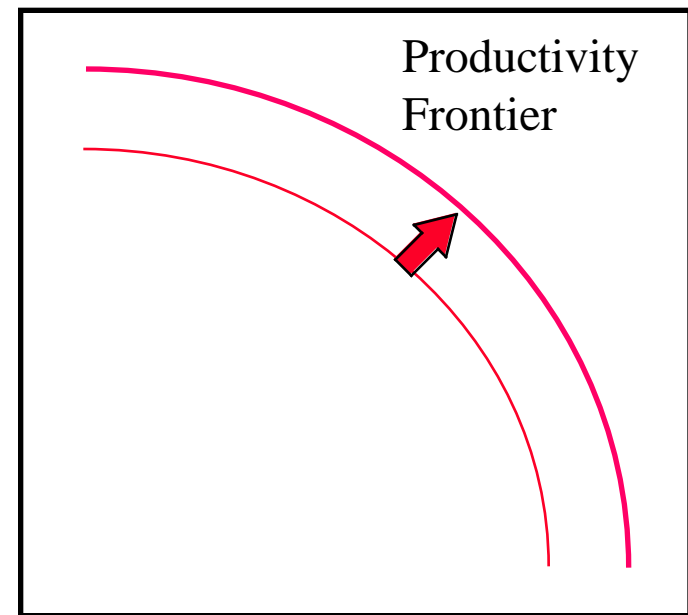
Competitive Space Selection

Operational Effectiveness¹

Nonprice value delivered to customer

high value

low value



high cost

low cost

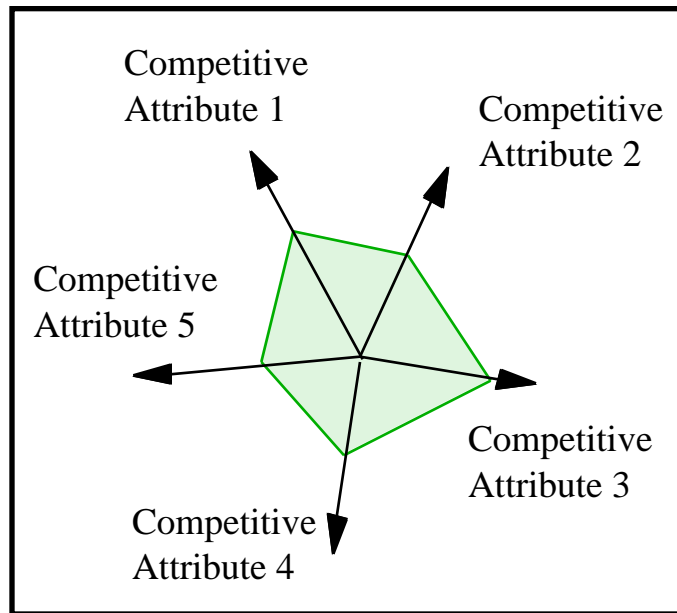
Relative cost position



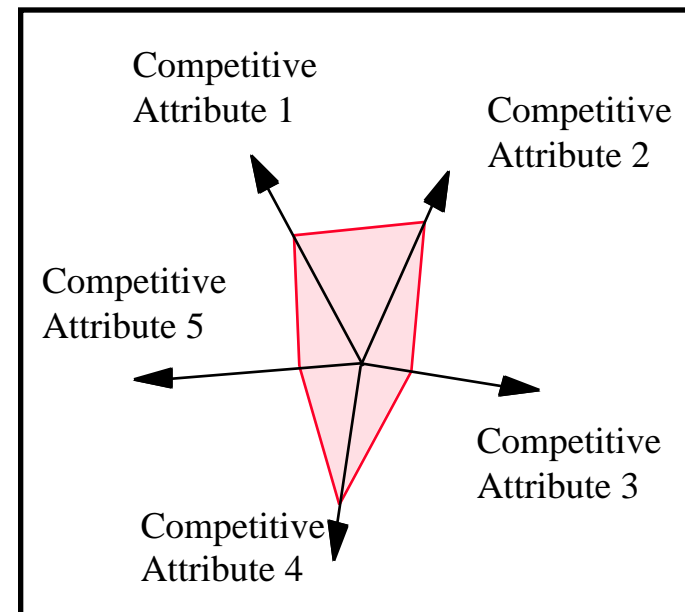
1. Source: "What is Strategy?," *Harvard Business Review*, (November-December 1996)

Strategy

Strategy A



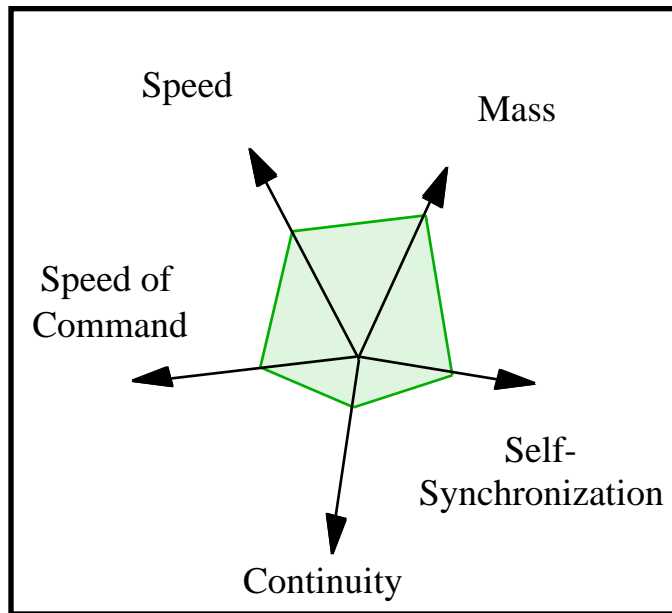
Strategy B



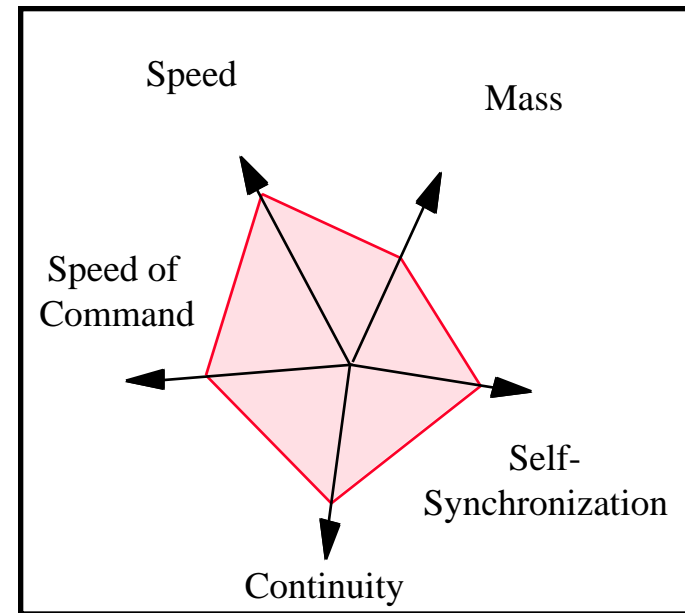
Strategy is About Selecting a Competitive Space

Strategy

Football



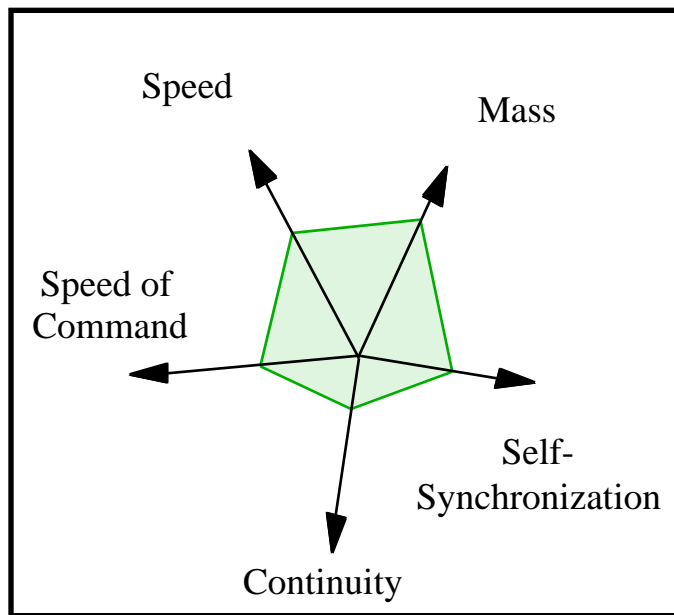
Soccer



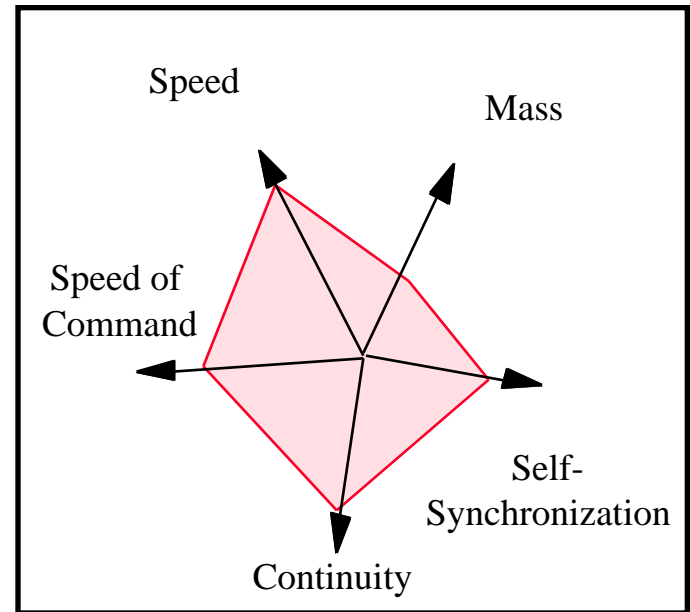
Strategy is About Selecting a Competitive Space

Strategy

Platform Centric Warfare

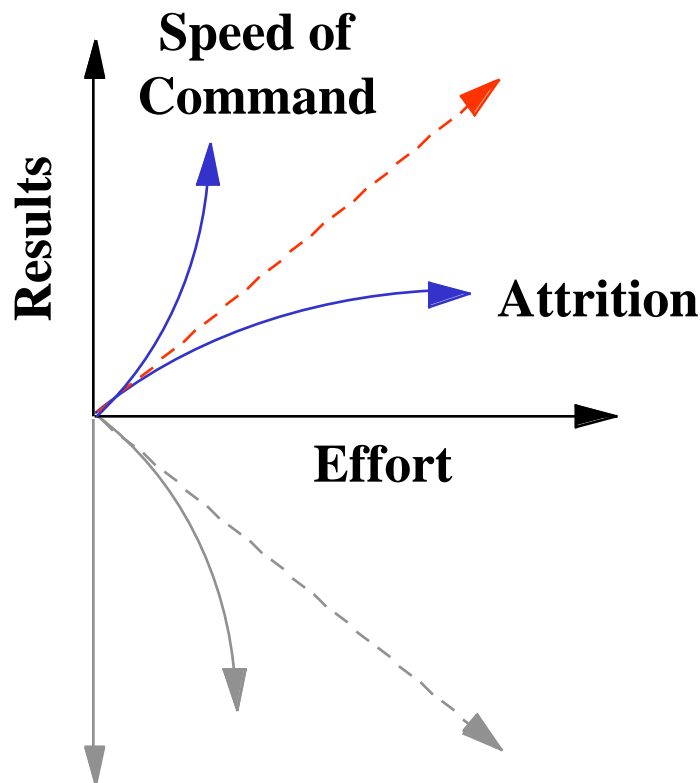


Network Centric Warfare



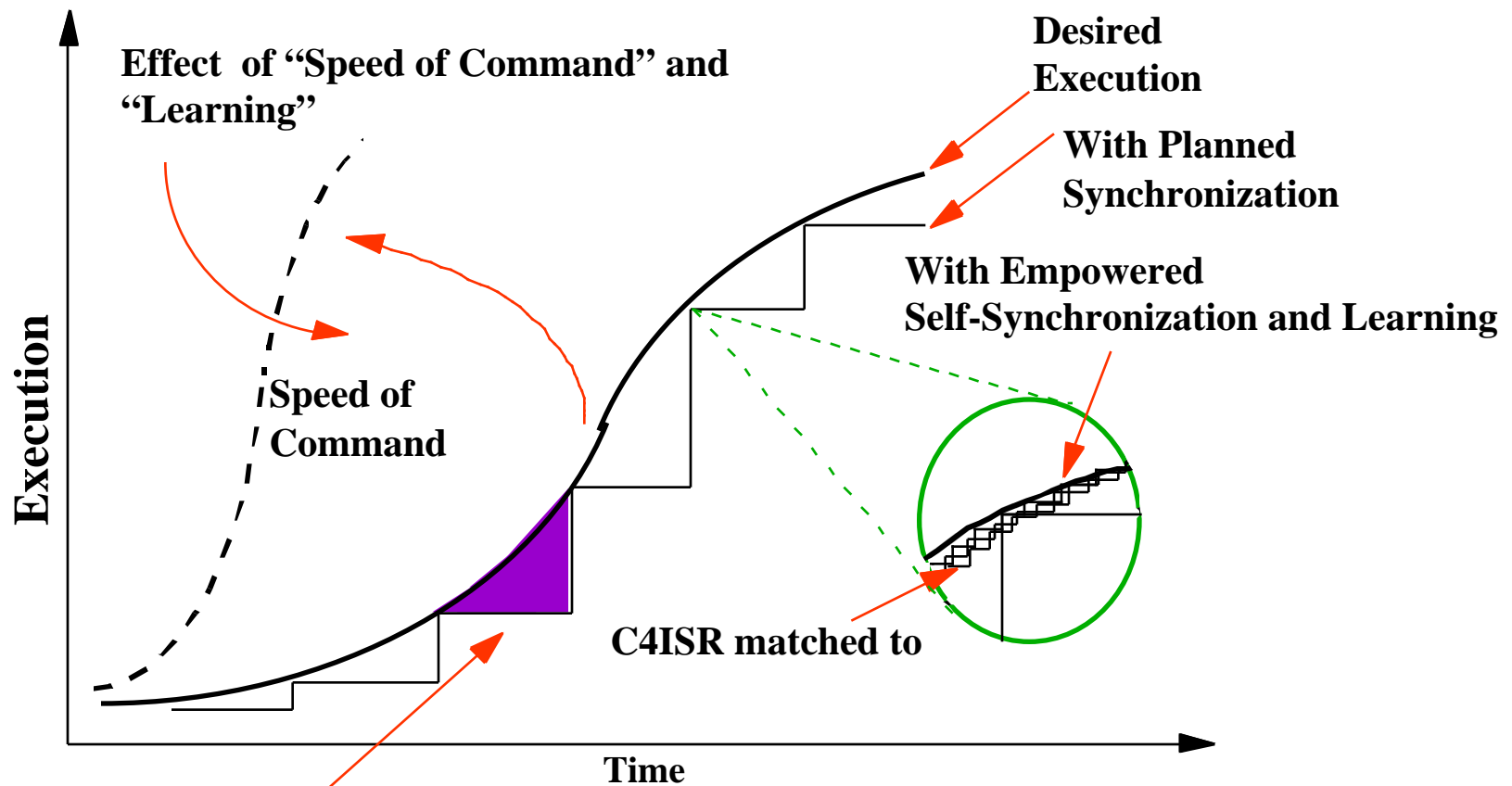
Strategy is About Selecting a Competitive Space

Attrition vs. Speed of Command



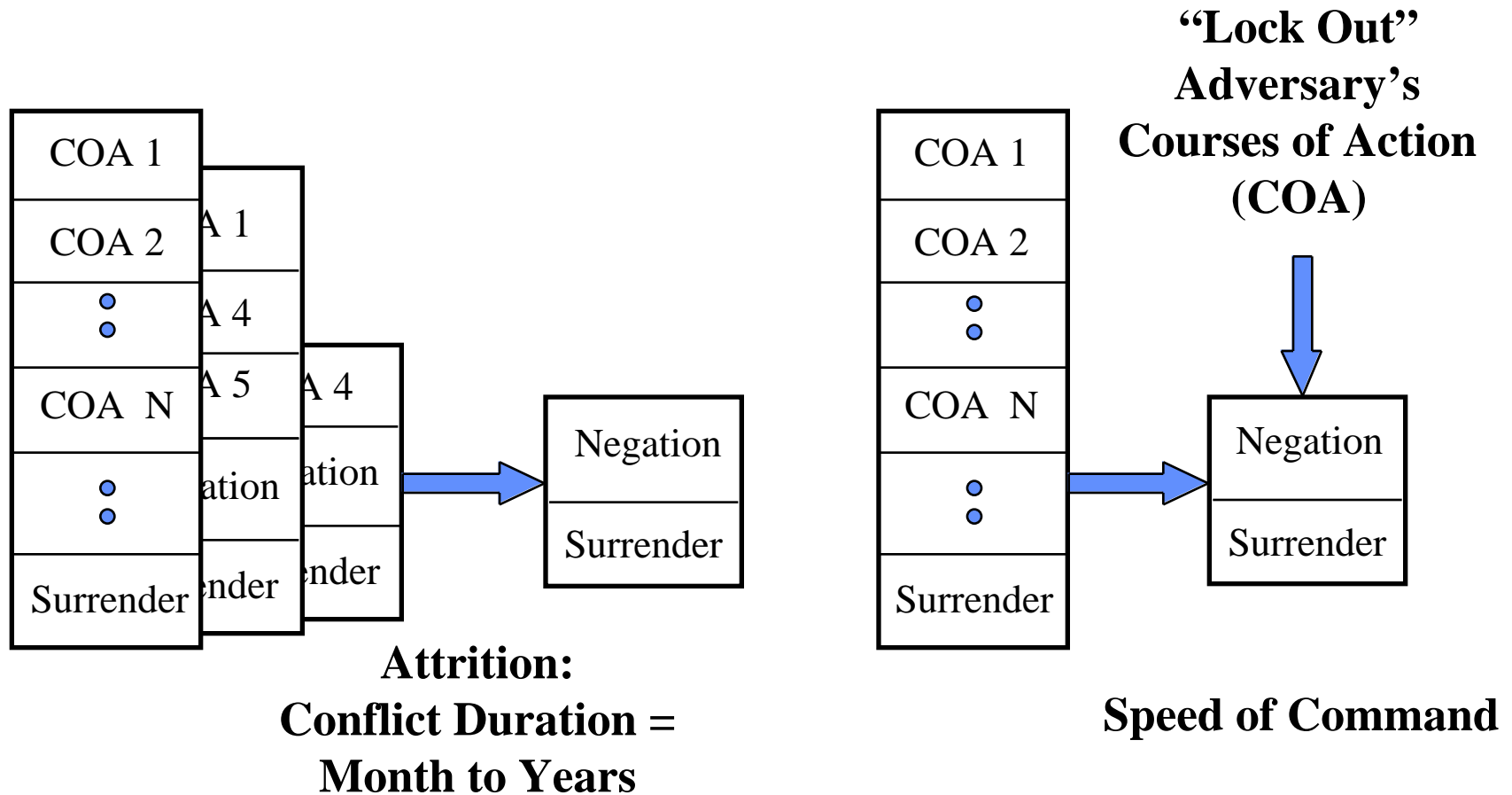
- Methods of achieving “Speed of Command”
 - Overwhelming early effort
 - Learning by gaining knowledge and experience faster (DBA/K & IW)
 - Change initial conditions positively (early effect vs. early effort)
 - Use early victories to offset technology inferiorities
 - Lock out enemy solutions
 - Apply effort on a high speed continuum vice a step function (self- synchronized vs. command synchronized)

Attrition vs. Speed of Command



$$\text{Lost Combat Power (CP)} = \int_a f(\text{Execution, Time})$$

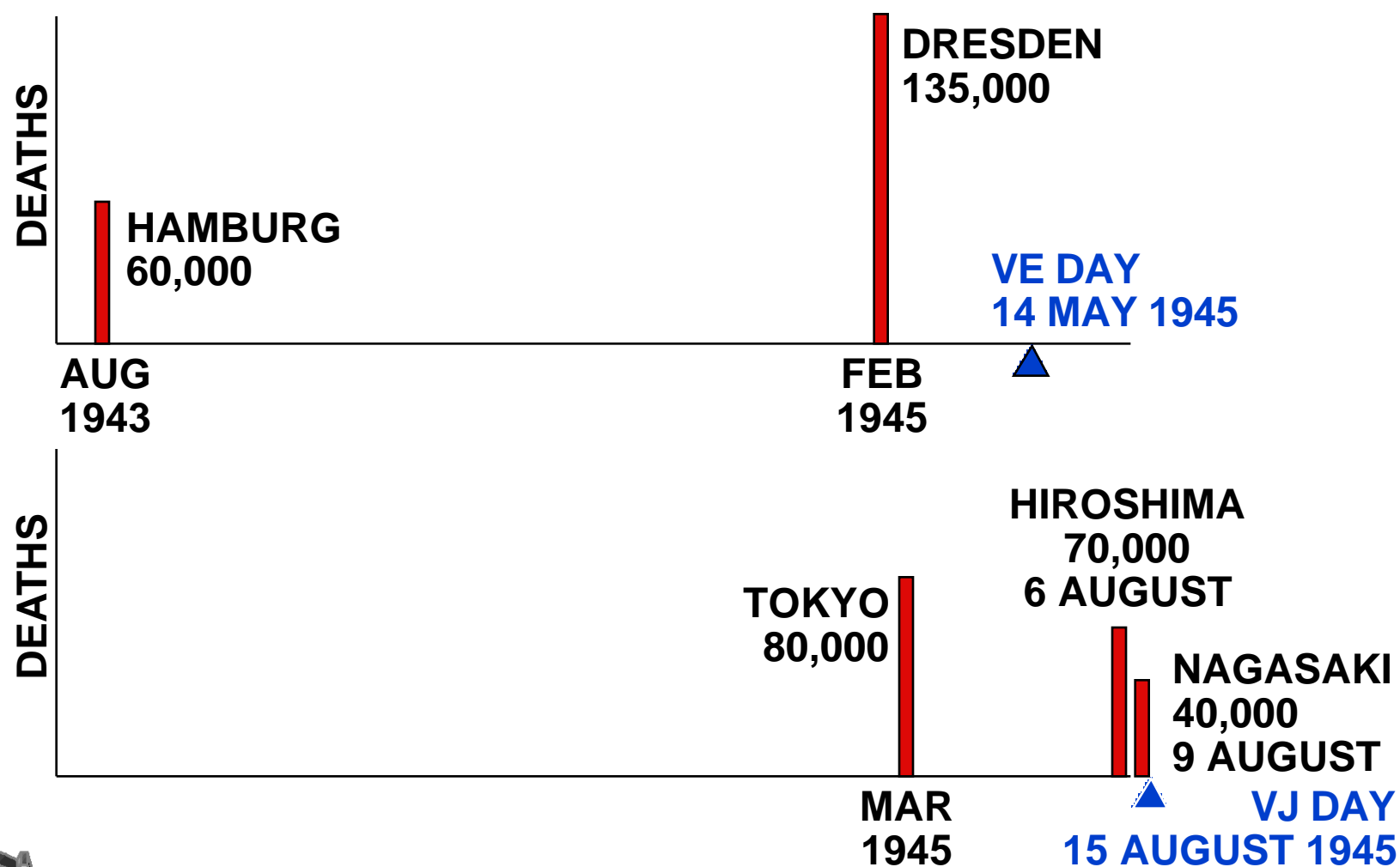
Attrition vs. Speed of Command



Emergence of Competition Based on Time



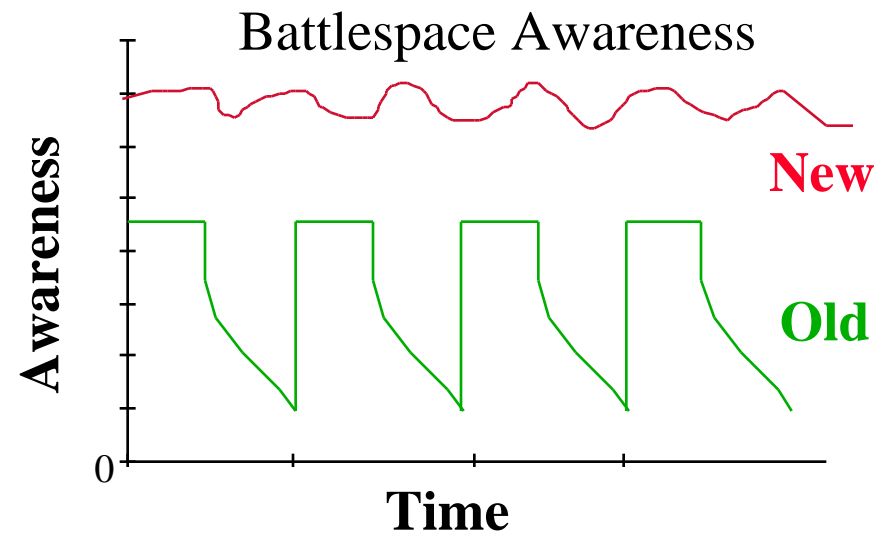
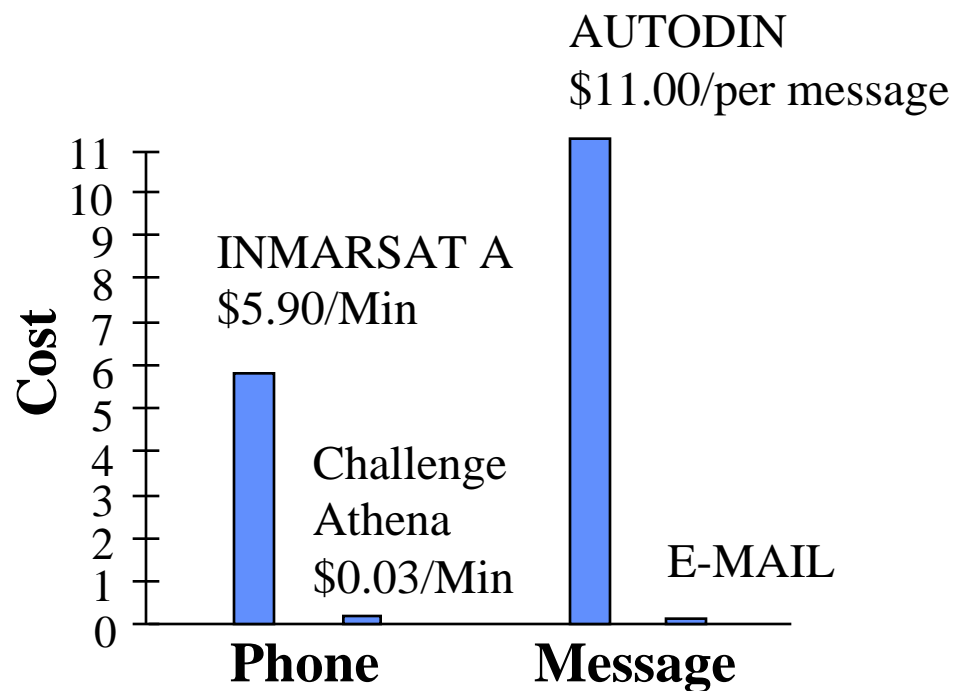
Attrition vs. Speed of Command



Sources: U.S. Strategic Bombing Survey, 1944-1947, and James Stokesbury, A Short History of Air Power, 1986.

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Speed of Command: Taiwan Straits



Higher Sustained Situational Awareness

- Enhances Speed of Command
- Lowers Ambiguity
- Reduces Questions
- Enhances Clarity of Mission and Intent



Warfare Case Study: Taiwan Straits

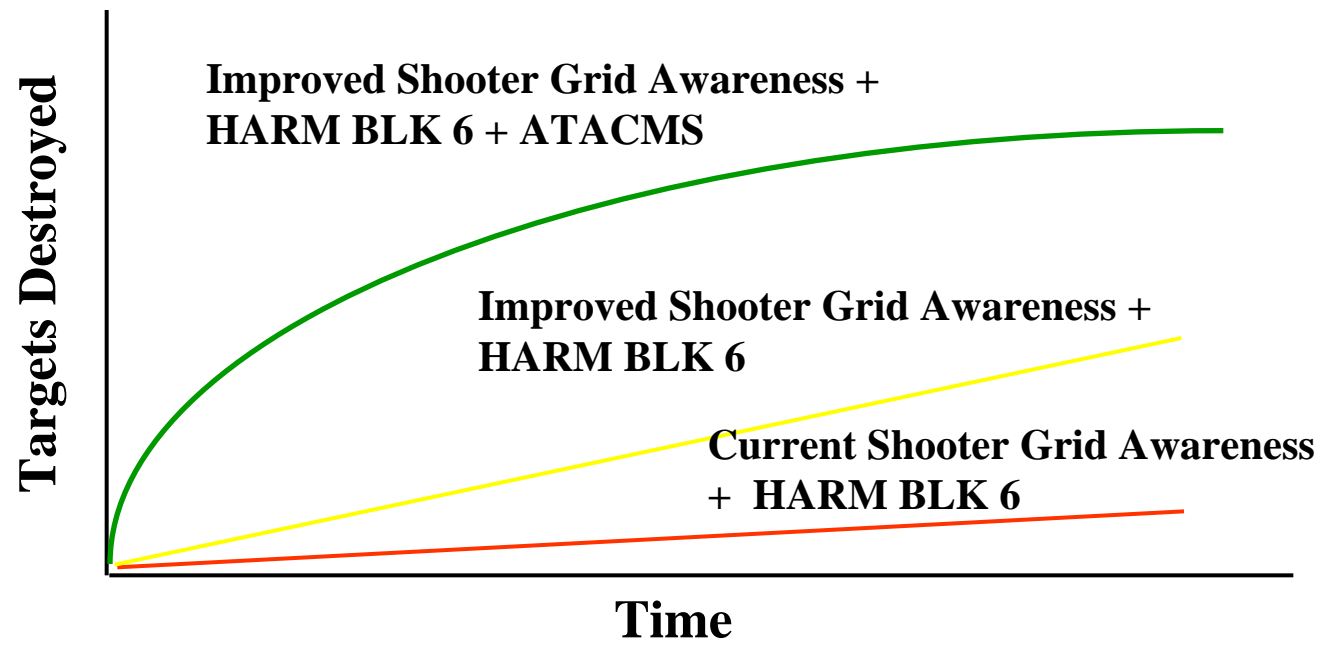
- **Scope**
 - Multi-sided live operations with high political risk and combat potential
 - Geographically dispersed Nimitz and Independence CVBGs, and USS Blue Ridge
 - Required extensive C7F, CTF 70, and USCINCPAC staff coordination
- **Observations**
 - Evidenced successful technology assimilation → coevolution
 - Evolution of Admiralship as a result of increased Battlespace Awareness
 - Timeline compression
 - Simultaneity
 - Collaboration
 - Graphics vs. Text
- **Conclusions**
 - Emergence of speed of command as decisive operational capability
 - Evolution of “Admiralship”
 - New capabilities necessitate a reevaluation of organization and doctrine
 - Naval and joint experimentation required



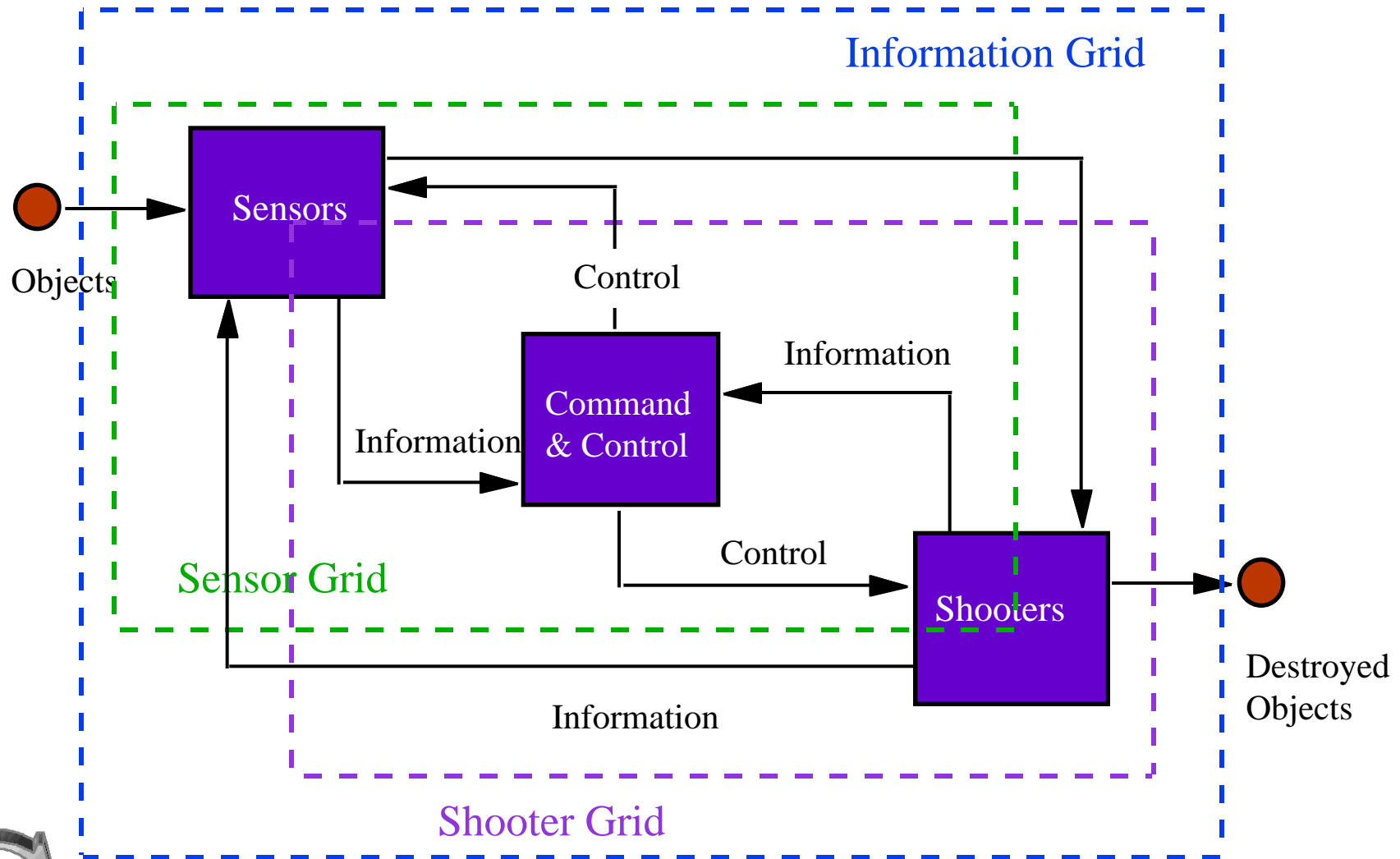
Network Centric Warfare Increases Joint Combat Power

Results for Precision Engagement

- **Operational Impact**
 - Dramatic Early Results
 - Greatest Rates of Change in Initial Phase of a Campaign
 - Inflicts Maximum Losses on the Enemy
 - Shortens Timelines
 - Locks out Enemy Options



Network Centric Warfare



Network Centric Warfare

- Platform Centric Warfare
 - Platforms generate combat power
- Network Centric Warfare
 - Networked platforms generate *increased* combat power

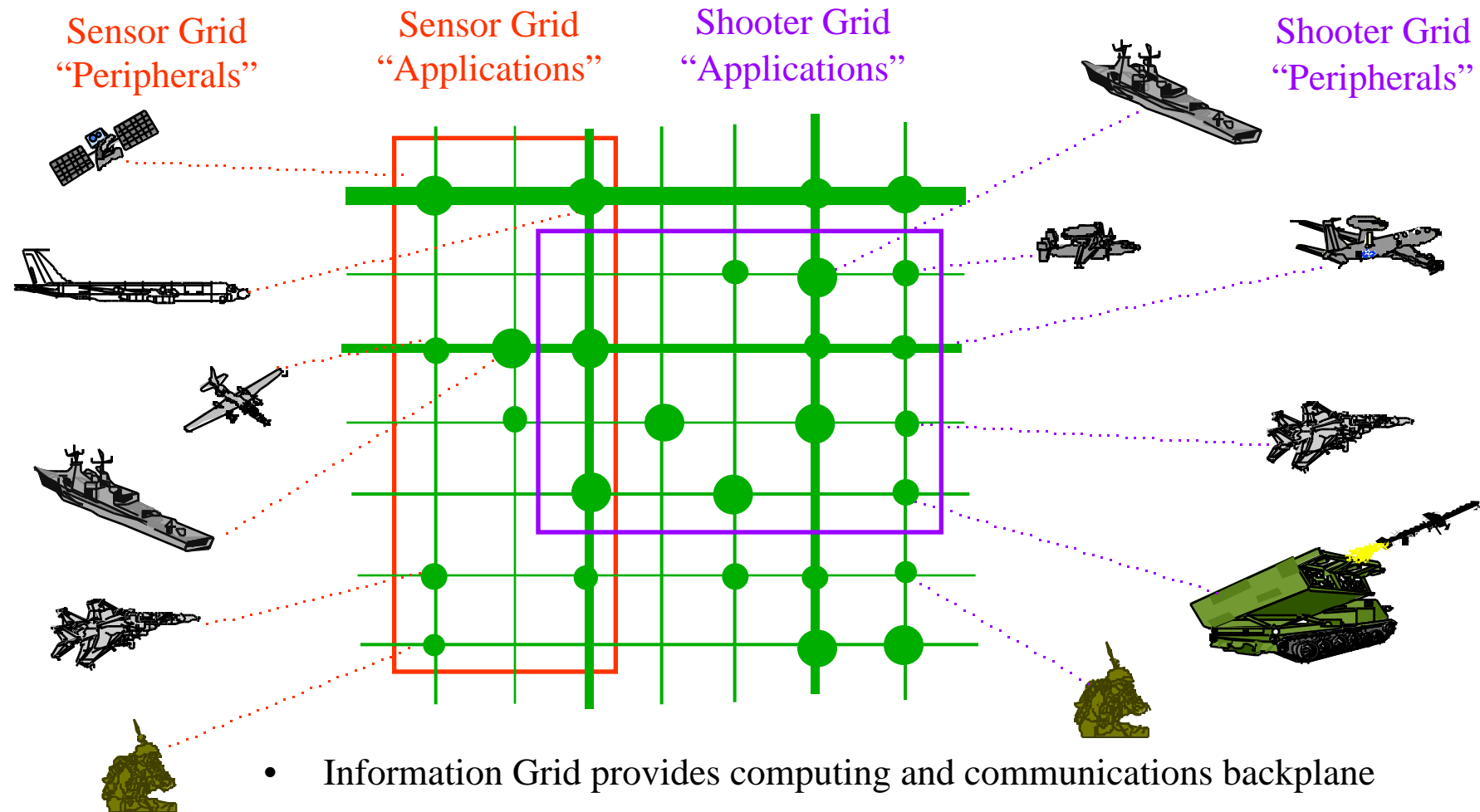
Metcalfe's Law

“The power (value) of a network increases as the square of the number of nodes in the network (N^2)”

Robert M. Metcalfe: The Inventor of Ethernet



Network Centric Warfare



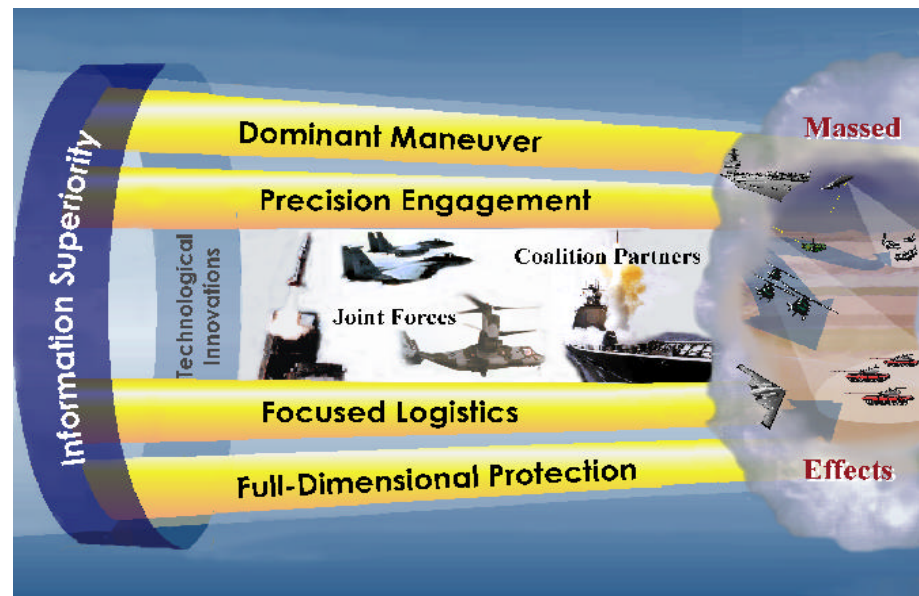
Network Centric Warfare

- **Sensor Grids**
 - **Generate Battlespace Awareness**
 - **Synchronize Battlespace Awareness with combat operations**
 - **Increase the Speed of Information**
- **Shooter Grids**
 - **Exploit Battlespace Awareness to generate increased Combat Power**
 - **Enable massing of effects vs. massing of forces**
 - **Maximize Joint Combat Power**
- **Network Centric Warfare**
 - **Changes the dynamics of competition in warfare**
 - **Enables Speed of Command**
 - **Rapidly “Locks Out” Adversary’s Courses of Action**
 - **Provides decisive competitive edge in warfare**



Conditions

- Necessary Condition:
 - Information Grid
- Necessary and Sufficient Conditions:
 - Information Grid
 - Sensor Grids
 - Shooter Grids



How Do We Get There?



Changing The Way We Change

- **Compelling need for coevolution**
 - **Organization and doctrine are lagging and decoupled from systems progress**
 - **Resistance is systemic and institutionalized**
- **Elements of a potential solution**
 - **Service experiments support Joint experimentation program**
 - » **Fleet Battle Experiments, Sea Dragon, Force XXI**
 - **Maritime Battle Center supports Joint Battle Center**
 - **Enterprise wide technology assimilation**
 - » **CIO provides standards for technical and operational interoperability**
 - » **Exploit technology: ATDs and ACTDs**
 - **Mechanisms for measuring progress**
 - **A climate which encourages innovation throughout the Fleet**



Implications: Intellectual Capital

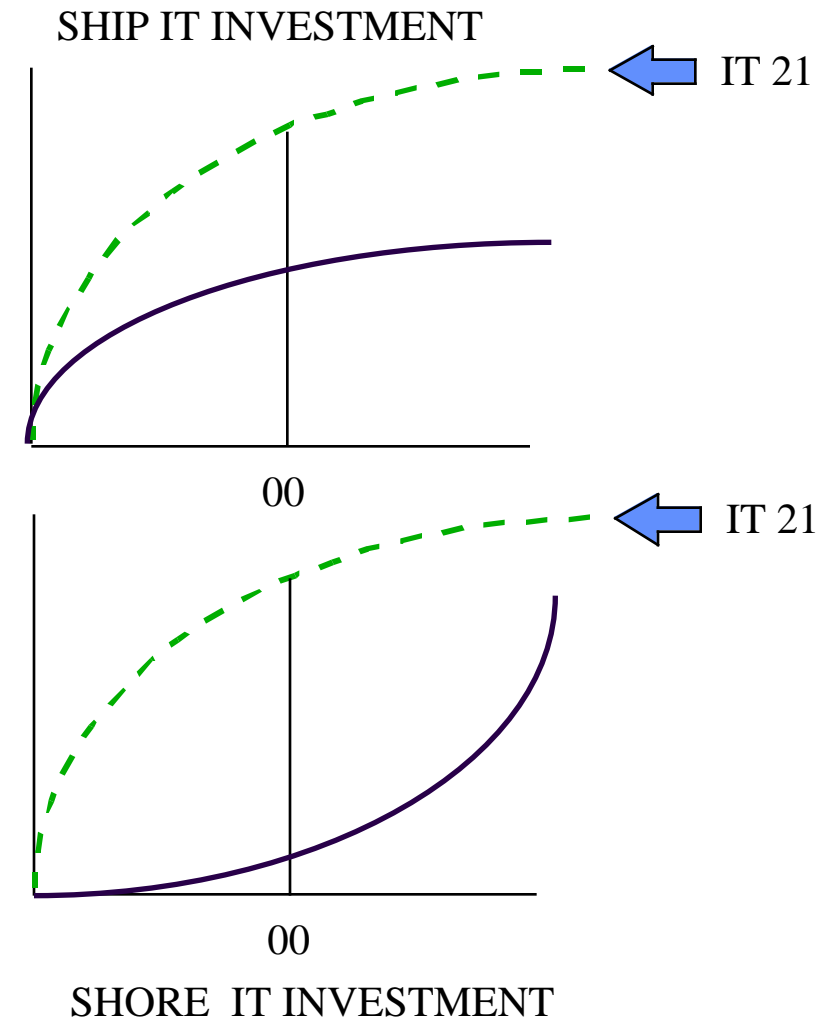
“There is today no real career path for personnel who will manage our critical information warfighting functions. Neither do we have a training program analogous to what we have for an F-18 pilot ... In order to fix this shortfall, we must start an aggressive C⁴ISR personnel development program, sooner rather than later.”

**Undersecretary of Defense (A & T)
Dr. Paul Kaminski
18 OCT 96**



Implications: Resource Allocation

- **Marginally Smaller**
- **Somewhat Leaner**
- **More Modern**
- **More Combat Capable**



Conclusions

Coevolving Ecosystems

- **Economy**
 - Changing Dynamics of Economic Growth
- **Business**
 - Changing Dynamics of Competition
- **Warfare**
 - Changing Dynamics of Competition
 - A Revolution in Military Affairs
 - » Platform Centric Warfare ➡ Network Centric Warfare



Conclusions

“The only thing harder than getting a new idea into the military mind is getting an old one out.”

-- BH Liddell Hart --

